

Six new species of fork-tailed catfishes (Pisces, Teleostei, Ariidae) from Australia and New Guinea

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ABSTRACT

Six new species of *Arius* (Teleostei: Ariidae) are described from estuarine waters of southern New Guinea and northern Australia. *Arius dioctes* sp. nov. is present in both regions and is distinguished by its large maximum size, small eyes, fixed (non-depressible) jaw teeth, broad mouth, and yellow lower body. *Arius insidiator* sp. nov. has a much depressed body, long, angular ribs, small eyes covered by skin and fixed jaw teeth. It too has a yellow lower body. *Arius pectoralis* sp. nov. is a slender catfish with strong, numerous serrae along the hind margin of the pectoral spines and dark margins on the dorsal, pectoral and the caudal fins. *Arius hainesi* sp. nov. has fleshy lips, small mouth, partly restricted gill openings, short barbels, ridges in the skin on the back below the dorsal fin, and often a dark mouth and branchial chamber. The barbels of *Arius hardenbergi* sp. nov. are thick proximally. This species also has a fleshy snout, an extensive head shield with broad supraoccipital process and a long-based adipose fin. *Arius paucus* sp. nov. is a freshwater species very similar to *Arius midgleyi* Kailola and Pierce and inhabits the river systems draining into the Gulf of Carpentaria.

KEYWORDS: Ariidae; fork-tailed catfishes; new species; Australia; New Guinea; tropical marine; tropical freshwater.

INTRODUCTION

The isolation of the Sahul Shelf has enabled the evolution of many endemic species of fork-tailed catfishes (Ariidae). These fish inhabit the rivers, estuaries and coastal waters of tropical (northern) Australia and New Guinea. Earlier workers (e.g. Roberts 1978; Haines 1979; Coates 1983, 1988; Allen and Coates 1990) have remarked on the adaptive characteristics of these ariids.

The Ariidae occurs worldwide in tropical and warm-temperate regions. It comprises at least 80 valid species and numerous nominal genera and species, many confined to particular geographic regions (west Africa, east Africa to India, South-east Asia, Australia-New Guinea, eastern Pacific, western Atlantic). The phylogenetic relationships of the family are under study.

Thirty-five species of ariid catfishes inhabit Australian and New Guinea waters and only five of these, all marine catfishes (*Arius thalassinus* Rüppell, 1837; *A. bilineatus* Valenciennes, 1840a; *A. argyropleuron* Valenciennes, 1840b, *A. nella* (Valenciennes, 1840b) and *A. polystaphylodon* Bleeker, 1846), occur elsewhere; in South-east Asian, Indian and east African (*A. thalassinus*) seas (Kailola 1990b). Of the remaining 30 taxa, five species (*A. nox* Herre, 1935; *A. solidus* Herre, 1935; *A. coatesi* Kailola, 1990a; *A. utarus* Kailola, 1990a; and *A. velutinus* (Weber, 1908)) are endemic to

northern New Guinea fresh waters, and 12 species are endemic to southern New Guinea fresh and saline waters (Kailola 1990b). Eleven more species are common to both northern Australia and southern New Guinea. Only two species - *Arius midgleyi* Kailola and Pierce and a new species - are endemic to Australia.

The Ariidae are under-represented in collections. Most species attain moderately large size and it is sometimes not easy for field workers to keep intact material. Moreover, surveys have only been conducted since the mid-1970s in some of the areas which now reveal new species. The haphazard nature of ariid collecting in often difficult environments has created the paradox, however, that two of the endemic ariids from New Guinea described in 1913 by Weber (*Doiichthys novaeguineae* and *Tetranesodon conorhynchus*) are represented today by less than ten specimens. Yet the distribution of these taxa spans the most intensively collected aquatic habitats of southern New Guinea.

I recognised nine Australo-Papuan ariid catfish taxa as new several years ago and three of them were described subsequently (Kailola and Pierce 1988; Kailola 1990a). Although I acknowledge the need of a phylogenetic review and comprehensive key to the species of this region, my objective here is to describe six new species. The other information will be published elsewhere.

METHODS

Abbreviations (such as for head length, standard length, gill rakers) and definition of arid features and relevant osteology have been described in Kailola (1983). Method of counting and measuring are defined in Kailola (1983) and Kailola and Pierce (1988). The term 'colour of fresh material' refers to freshly dead (just caught) or chilled specimens except for *A. insidiator*, where 'fresh colour' refers to frozen specimens. The term 'serrae' refers to large, regularly-spaced serrations.

Institutional abbreviations follow Leviton *et al.* (1985) and are: AMS (Australian Museum, Sydney); CSIRO (Ian S.R. Munro Ichthyological Collection, CSIRO, Hobart); KFRS (Kanudi Fisheries Research Station collection, Port Moresby, Papua New Guinea); NTM (Museum and Art Gallery of the Northern Territory, Darwin); QM (Queensland Museum and Art Gallery, Brisbane); USNM (United States National Museum, Smithsonian Institution, Washington); WAM (Western Australian Museum, Perth); ZMA (Zoölogische Museum, Universiteit van Amsterdam, Amsterdam).

KFRS material of these new species identified ten years ago generally is not included in the type series as the present whereabouts and condition of the material is unknown. However, an exception was made for two new species because of the paucity of material.

SYSTEMATICS

Arius dioctes sp. nov.

(Figs 1-2; Tables 1-2)

Hexanematichthys sp - Kailola 1975: 41 (in part).*Hexanematichthys* sp 'Y' - Kailola and Wilson 1978: 42.*Arius* cf. *stirlingi* - Roberts 1978: 37, fig.16a.*Arius* sp. - Maunsell and Partners 1982: 181. - Allen 1991: 56, photo 14.*Arius* (*Hemiarius*) species 1 - Kailola 1990b: 299.*Hemiarius* sp.1 - Blaber, Brewer and Salini 1994: 163, fig 3a.

Type material. HOLOTYPE - CSIRO C.3798, 430 mm SL, Norman River at Karumba (17°29' S, 140°50' E), Queensland, D. J. Turner, 1969. PARATYPES - NTM S.11190-001, 2 (450-460 mm SL), Fog Bay (12°54'S, 130°14'E), Northern Territory, P. Mundy, June 1983; AMS I.15557-041, 2 (103-172 mm SL), Gulf of Carpentaria at 17°26'S, 140°40'E., I.S.R. Munro, 23 December 1963; AMS I.29292-001, 159 mm SL, Gulf of Papua (08°00' S, 145°00' E), S. Frusher, 11 July 1981; CSIRO H.5154-01, 1050 mm SL, Papua (Irian Jaya) at 04°49'S, 137°00'E, K. Hortle and A. Haris, 7 December 1996; NTM S.14828-005, 95.1 mm SL, Papua (Irian Jaya) at 04°55'S, 137°15'E, K. Hortle and A. Haris, 28 May 1998; KFRS F.O4094, 200 mm SL, off Oreke River

mouth (08°42' S, 146°29' E), Papua New Guinea, J. Koaia, May 1973.

Additional material examined (non-type). KFRS F.5627-01, 350 mm SL, Tirere village, north side of Daru Island (09°05' S, 143°12' E), Papua New Guinea, April 1988; KFRS F.5626-03, 330 mm SL, Sagero, north side of Daru Island, Papua New Guinea, September 1988; KFRS F.5729-03, 166 mm SL, Daru Island, Papua New Guinea, 30 September 1983; KFRS FO3992, 10 (84-89 mm SL), Pie River at Baimuru (07°33' S, 144°51' E), Papua New Guinea, 28 September 1971 (juveniles from mouth of an adult male, 104 cm SL); KFRS F04099, 328 mm SL, old Kukipi village, Lakekamu River mouth (08°12' S, 146°10' E), Papua New Guinea, 18 October 1971; CSIRO H.4957-01, 4 (86-94 mm SL), Papua (Irian Jaya) at 04°55'S, 137°03'E, K. Hortle and A. Haris, 28 May 1998; CSIRO H.4976-04, 325 mm SL, Papua (Irian Jaya) at 04°53'S, 136°55'E, 6 September 1997.

Diagnosis. Teeth very strong, non-depressible; in narrow bands in jaws and in four patches arranged across front of palate. Snout prominent, jaw teeth exposed; mouth wide. Head somewhat venulose, head shield almost smooth. Eye small, free of head skin, 6-14 % HL; few (10-11) first arch gill rakers; no rakers on posterior face of first two arches; gill opening wide. Body orange-yellow; lips, inside mouth and body usually covered with orange or yellow mucus, and teeth frequently reddish.

Description. D 1,7. P I,11-12. A 17-21. GR (first arch) 10-11 of which 3-4 on upper limb. GR (last arch) 9-11. Vertebrae 49-50 (42-43 free).

Body robust anteriorly, tapered, well compressed posteriorly. Predorsal profile straight becoming convex at nape. Snout prominent, well-rounded; inner lip margin scalloped. Jaws strong; mouth wide, curved, subterminal or inferior. When mouth closed, tooth band in upper jaw almost completely exposed, outer rows of lower jaw teeth also visible. Nostrils large, ovate, anterior one directly before posterior one. Eye ovate, moderately small, border completely free from head skin; eye dorsolateral, well before mid-head length. Gill opening wide, membranes broadly scalloped, meeting at sharp angle, leaving broad, free margin.

All teeth sharp, strong, conical, not depressible. Premaxillary tooth band with 4-6 irregular series of teeth; mandibular tooth band with 4-5 series of teeth, almost continuous across symphysis. Four patches of teeth in row across anterior of palate: two inner (vomerine) patches separated by narrow gap at midline, half as wide as outer, curved patches; 3-4 rows of teeth in each group. Palate smooth anteriorly, longitudinally creased posteriorly, with two long, low ridges of epithelial tissue before branchial chambers.

Head shield smooth anteriorly; several groups of sharp granules laterally, distinct parallel striae adjacent to distal third of dorsomedian head groove, striae

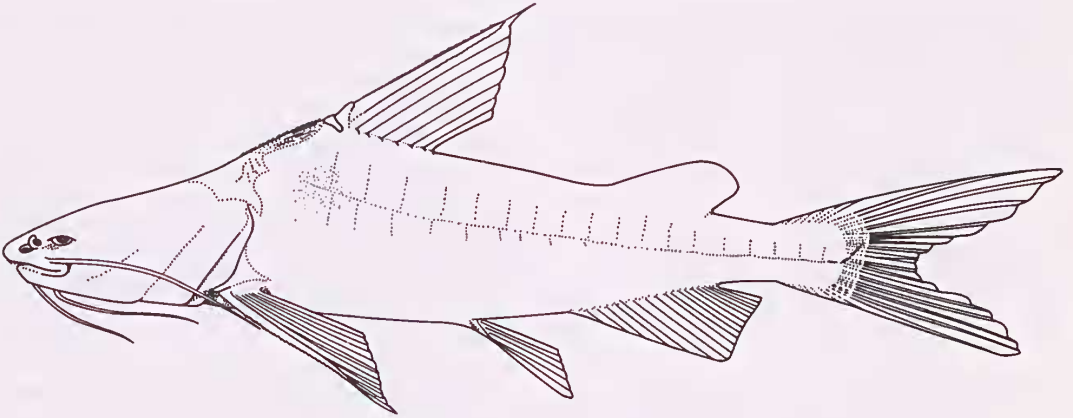


Fig. 1. *Arius dioctes* sp. nov. lateral view, 200 mm SL paratype.

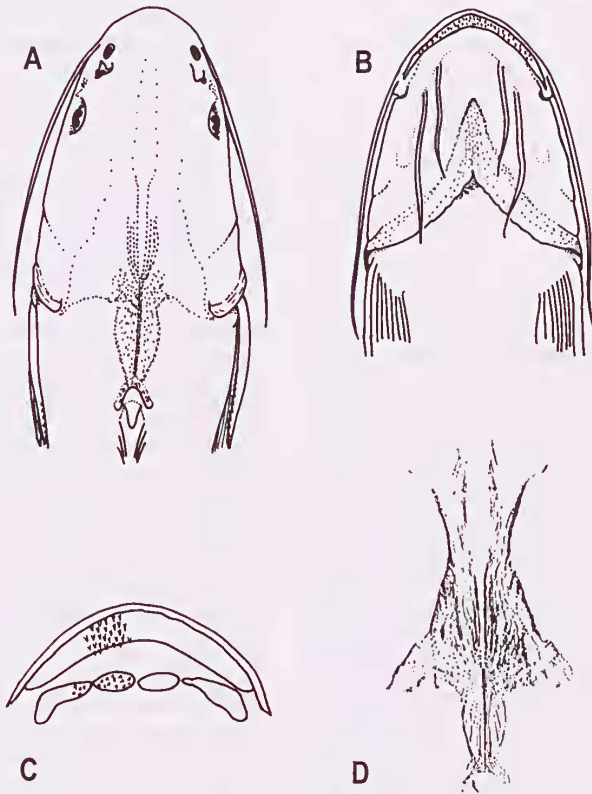


Fig. 2. *Arius dioctes* sp. nov. (all 200 mm SL paratype) A, dorsal head view; B, ventral head view; C, arrangement of upper tooth patches; D, rubbing of head shield.

Table 1. Principal meristics of six new species. n = number; \bar{x} = mean, SD = standard deviation; GR 1 = rakers on first gill arch; GR 4 = rakers on last gill arch.

Species	variable	Anal rays	Pectoral rays	Total GR 1	Total GR 4
<i>A. dioctes</i>	holotype	20	12	10	10
	range, n = 9	17-21	11-12	10-11	9-11
	\bar{x}	18.7	11.6	10.3	10.0
	SD	1.4	0.5	0.5	0.7
<i>A. insidiator</i>	holotype	20	10	12	12
	range, n = 4	19-23	10	11-12	11-13
	\bar{x}	20.5	10.0	11.5	11.5
	SD	1.7	0.0	0.6	0.8
<i>A. pectoralis</i>	holotype	18	8	15	15
	range, n = 16	18-22	8-11	15-22	14-17
	\bar{x}	19.3	10.0	18.8	15.3
	SD	1.2	0.9	1.8	1.1
<i>A. hardenbergi</i>	holotype	18	10	14	13
	range, n = 5	16-18	9-10	10-14	9-13
	\bar{x}	16.6	9.4	11.2	9.8
	SD	0.9	0.5	1.6	1.8
<i>A. hainesi</i>	holotype	20	10	32	36
	range, n = 14	20-23	8-11	32-37	31-37
	\bar{x}	21.7	9.6	34.3	33.5
	SD	0.7	0.8	1.4	1.7
<i>A. paucus</i>	holotype	17	10	11	13
	range, n = 16	16-18	9-10	10-11	11-14
	\bar{x}	17.3	9.9	10.7	12.8
	SD	0.8	0.3	0.5	0.8

extending over supraoccipital process. Dorsomedian groove narrow, lanceolate, flat, extending from between nostrils to supraoccipital process base. Supraoccipital process with sharp, distinct keel, straight to slightly convex sides. Predorsal plate angular, striate. Numerous, anastomosing venules over anterior two-thirds and sides of head, continuing onto shoulder. Rugose humeral process anteroventrally well ossified, forming narrow flange; acute, triangular shaft of process reaching one-quarter to one-third along pectoral fin spine. Axillary pore small and slit-like.

Barbels thin distally. Maxillary barbel attains end of humeral process in juveniles, to well before opercular margin in adults. Mandibular barbel reaches opercular margin in young, preopercular margin in adults. Mental barbel extends short distance behind eye. Chin barbel bases staggered.

Gill rakers rigid, pungent, half to two-thirds length of opposing filaments. No rakers along posterior face of first two gill arches, 9-11 along posterior face of third arch. Low, muscular thickening posterodorsally on smooth arches.

Fin spines thick, slightly curved, rounded, patterned with fine rugae and granules. Anterior margin of spines with distinct granules proximally, 6-10 anteriorly, low

serrae distally; posterior margin with 8-30 serrae or denticles. Short filament on spine tips. Longest dorsal ray 1.9-3.2 times longer than last ray. Pectoral fin low, extending to below dorsal fin. Ventral fin narrow in males, ending well before anal fin origin. Fin in females broad, attains anal origin or beyond (inner rays thicken and form pad of tissue in sexually mature individuals). Adipose fin moderately high, oblong, originating approximately opposite anal fin origin. Anal fin margin almost truncate, longest ray 2.1-3.6 times last ray. Caudal fin lobes broad-based, strongly tapered, upper lobe slightly longer than lower.

Caudal peduncle shallow. Lateral line straight, oblique below dorsal fin, strongly upturned at tail base. Short lines and ascending rows of pores branch off from lateral line, numerous and extensive anteriorly.

Colour of fresh material. Greenish or pale bluish grey above; pale orange or yellow on sides and below, less often cream or white. Bright yellowish orange mucus over all of body; lips and inside of mouth also yellow. Barbels and teeth reddish or yellow. Fins bluish grey, green or yellowish, dusky towards margins. Snout and head of some individuals blotched black.

Colour of preserved material. Pinkish brown or tan above, cream or pale fawn below, top of head darker brown. Fins brown or light tan, margin of dorsal fin and caudal fin dark brown; upper aspect of pectoral fin, ventral fin and mid-anal fin rays darker brown. Maxillary barbel dark brown, others pale. Peritoneum grey.

Comparisons. *Arius dioctes* is similar to *A. stormii* (Bleeker, 1858), a South-east Asian species growing to over 50 cm long (Weber and de Beaufort 1913). However, *A. stormii* possesses the following unique features: dorsal spine subequal to head length (versus equal to head length without snout in *Arius dioctes*); caudal peduncle depth 2.6-2.8 in its length (versus 1.9-2.3 in *Arius dioctes*); anterior nostrils lateral to posterior ones (versus anterior to posterior nostrils in *Arius dioctes*); total gill rakers on the first arch 17-18 (versus 10-11 in *Arius dioctes*); serrae on front margin of dorsal spine directed upwards (versus directed downwards in *Arius dioctes*); fin spines very broad (versus moderately broad in *Arius dioctes*); adipose fin beginning before anal origin (versus opposite or behind in *Arius dioctes*).

The most phenotypically similar species to *Arius dioctes* in Australia and New Guinea is *A. armiger* De Vis, 1884 (distinguished by its venulose head, small eye and strong teeth). The taxa can easily be distinguished however, on gill raker and anal fin meristics (*A. armiger* has GR16-22, first arch; A 22-25) and maxillary barbel length (long maxillary barbel reaches at least to below dorsal fin). *Arius dioctes* has similar colouration and dentition to *Arius insidiator* sp. nov. However, the form of the body easily distinguishes these two taxa.

Distribution. *New Guinea:* southern coast and rivers from Kamora River to the Otokwa River, possibly also

Table 2. Percent of head length (HL) and standard length (SL) for *Arius dioctes* sp. nov. and *Arius insidiator* sp. nov. n = sample size; \bar{x} = mean; SD = standard deviation.

Character	<i>Arius dioctes</i>					<i>Arius insidiator</i>				
	holotype	n	range	\bar{x}	SD	holotype	n	range	\bar{x}	SD
Percent of HL										
head height	38.1	9	38.1 - 50.0	42.9	4.0	39.8	4	35.0 - 39.8	37.7	2.3
head width	66.3	9	61.3 - 71.3	66.3	2.9	64.1	4	61.9 - 64.9	64.4	2.0
eye diameter	6.8	9	5.7 - 13.2	8.8	2.5	6.0	4	5.6 - 6.8	6.0	0.5
mouth gape	47.3	9	44.7 - 52.3	47.4	2.5	44.3	4	42.8 - 45.8	44.0	1.2
interostril distance	35.7	9	33.1 - 35.9	34.8	1.1	31.4	4	31.4 - 34.7	32.4	1.5
snout length	34.7	9	32.2 - 37.2	34.4	1.5	27.8	4	27.8 - 31.6	29.0	1.8
longest barbel length	54.4	9	40.7 - 77.4	61.3	13.2	32.4	4	32.4 - 52.0	40.1	8.5
bony interorbital width	33.1	8	26.6 - 35.4	31.7	3.2	25.8	4	25.8 - 27.8	26.5	0.9
occipital proc. length	28.1	9	25.5 - 34.4	29.6	2.6	28.8	4	28.8 - 36.9	33.0	3.5
occipital proc. width	18.4	9	13.7 - 21.8	16.9	3.2	10.1	4	8.3 - 15.1	10.8	3.0
Percent of SL										
HL	31.4	9	31.4 - 34.7	32.5	1.1	32.6	4	29.8 - 32.6	31.1	1.2
head height	12.0	8	12.0 - 16.3	14.0	1.4	13.0	4	10.6 - 13.0	11.7	1.0
head width	20.9	9	19.5 - 22.9	21.5	1.0	20.9	4	18.8 - 21.1	20.0	1.1
eye diameter	2.1	9	2.0 - 4.0	2.8	0.7	1.9	4	1.8 - 2.1	1.9	0.2
mouth gape	14.9	9	14.2 - 16.5	15.4	0.7	14.4	4	13.0 - 14.4	14.0	0.6
interostri distance	11.2	9	10.7 - 12.3	11.3	0.5	10.2	4	9.4 - 11.0	10.1	0.7
snout length	10.9	9	10.5 - 12.3	11.2	0.6	9.1	4	8.5 - 10.0	9.0	0.7
longest barbel length	17.1	9	14.1 - 24.7	19.9	4.2	10.5	4	10.5 - 16.4	12.5	2.7
bony interorbital width	10.4	8	8.5 - 11.4	10.3	1.1	8.4	4	7.9 - 8.4	8.2	0.3
occipital proc. length	8.8	9	8.7 - 10.9	9.6	0.8	9.4	4	9.4 - 11.2	10.2	0.8
predorsal length	39.4	9	39.4 - 42.8	41.1	1.1	37.3	4	35.4 - 37.3	36.3	0.9
length dorsal f. base	10.8	9	10.0 - 13.2	11.6	0.9	10.3	4	10.3 - 12.2	10.3	0.9
interdorsal length	22.8	9	21.6 - 25.7	23.6	1.3	28.8	4	25.1 - 28.8	6.0	0.4
length adipose f. base	10.4	9	8.0 - 12.3	10.4	1.4	9.0	4	9.0 - 11.1	10.0	0.9
length anal f. base	16.9	9	13.3 - 16.9	15.3	1.3	15.1	4	15.1 - 17.0	16.0	0.9
caudal ped. depth	6.5	9	6.5 - 7.3	6.9	0.3	6.3	4	6.2 - 7.1	6.5	0.4
caudal ped. length	13.8	9	11.2 - 17.7	14.4	2.0	14.5	4	13.3 - 15.0	14.3	0.7
pectoral spine length	19.5	8	17.3 - 21.3	19.6	1.6	15.0	4	15.0 - 16.4	16.0	0.6
dorsal spine length	21.8	8	17.1 - 23.2	21.1	2.4	16.8	4	15.6 - 18.3	16.9	1.3

further westward and in intermediate rivers; from there eastwards to the middle and lower river and delta of the Fly, throughout the Gulf of Papua rivers including the Kikori, Era, Pie and Purari systems and deltas, Vailala River mouth, Murua River, Lakekamu and Oreke Rivers. *Australia*: northern coast and rivers from the Adelaide and Alligator Rivers to the Gulf of Carpentaria and the Norman River.

Ecology. Coastal and lower mangrove areas, estuaries into main rivers and lagoons; also freshwater.

Remarks. In late 1976, this species was the second most important commercial species at Kikori (Papua New Guinea) after barramundi (*Lates calcarifer* (Bloch) (Haines 1979). *Arius dioctes* has been recorded to attain 1.2 m SL (Roberts 1978) and 19 kg whole weight (T. Coleman pers. comm.). Papuan villagers report that this species can attain 2 m in length. N. Haysom and T. Davis (pers. comm.) have collected 1-2 m, 'up to 40 kg' fish from the Alligator and Norman rivers. The 1050 mm SL paratype from Papua (Irian Jaya) weighed c. 15 kg when fresh.

Etymology. *dioctes*, masculine. From the Greek, *dioktes*, meaning hunter or pursuer - in reference to the species' apparent hunting ability, diet and dentition.

Arius insidiator sp. nov.

(Figs 3-4; Tables 1-2)

Hexanematichthys sp - (in part) Kailola 1975: 41.

Hexanematichthys sp 'D' - Kailola and Wilson 1978: 40, 42.

Arius (Hemiaris) species 5 - Kailola 1990b: 306.

Type material. HOLOTYPE - NTMS.11189-001, 350 mm SL, mouth of Wildman River (12°26' S, 132°09' E), Northern Territory, P. Mundy, 28 February 1984. PARATYPES - AMS I.28960-001, 282 mm SL, Gulf of Papua (08°00' S, 145°00' E), S. Frusher, 1978; KFRS F.O3302, 188 mm SL, half mile inside Pai'a Inlet (07°39' S, 144°33' E), Papua New Guinea, F.R.V. *Tagula*, 6 May 1967; KFRS F.5526-01, 270 mm SL, off Kerema (07°58' S, 145°43' E), D. Whitten, D. Coates and R. Watson, 11 October 1983.

Diagnosis. Head and anterior of body depressed; ribs long, angular, impressed in abdominal body wall. Eye covered with head skin; head smooth. Mouth wide, terminal, jaws upturned at symphysis; teeth fixed, cardiform, in 1-2 series on jaws and palate; four elongate patches of palatal teeth. No rakers on posterior of first two arches; mandibular barbel longest, reaching dorsal fin. A 19-23; total gill rakers (first arch) 11-12; total vertebrae 24+3+33. Fin spines slender, weak. Fresh

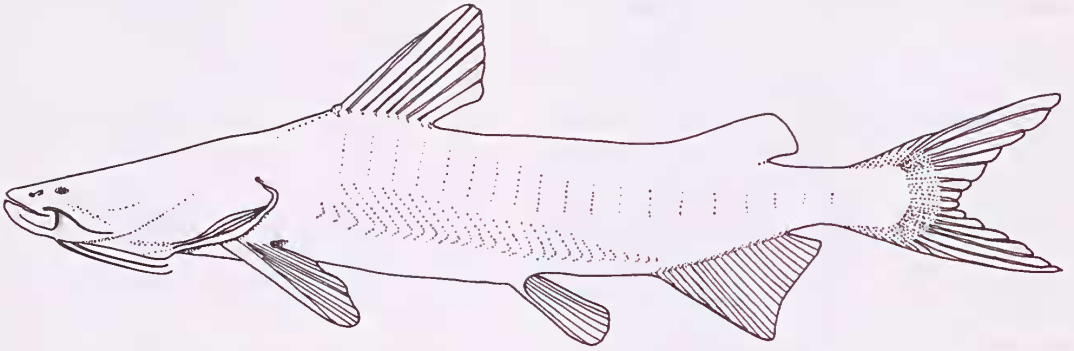


Fig. 3. *Arius insidiator* sp. nov. lateral view, holotype

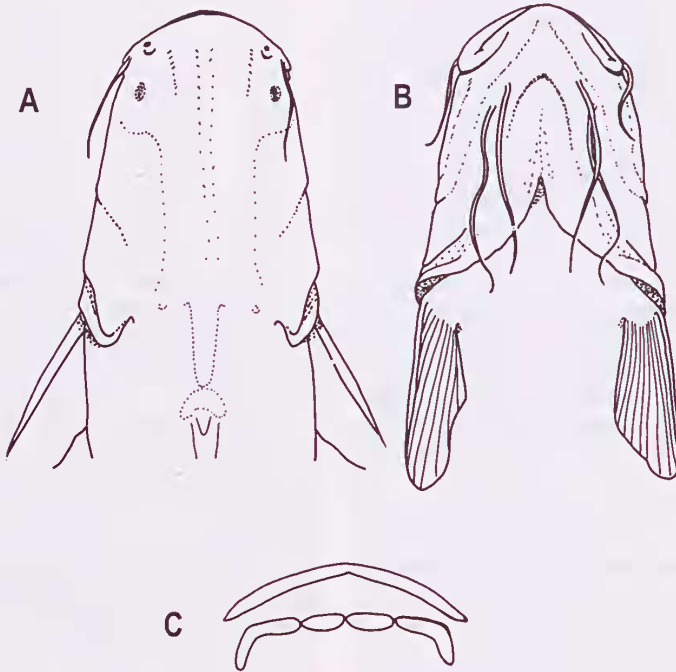


Fig. 4. *Arius insidiator* sp. nov. A dorsal head view; B, ventral head view (both of holotype); C, arrangement of upper tooth patches (188 mm SL paratype).

colouration grey or yellowish, fins and mouth (bright) yellow or orange.

Description. D 1,7. P 1,10. A 19-23. GR (first arch) 11-12, of which 5 on upper limb. GR (last arch) 11-13. Vertebrae 58-60 (51-54 free).

Body moderately stout, anterior two-thirds depressed; angular pleural ribs of trunk and anterior caudal vertebrae apparent through body wall, forming a 'shelf' along lower sides. Predorsal profile almost straight. Snout evenly rounded; lips narrow, much thickened at corners, scalloped along inner margin. Jaws strong, lower jaw elevated at symphysis, slightly longer than upper; mouth terminal to superior, broad, curved; teeth not visible when mouth closed. Nostrils small, rounded, placed well forward on snout; anterior one directly in front of posterior one. Eye ovate, small, covered with head skin, almost dorsally situated and about four eye diameters before mid-head length. Gill opening wide, membranes meeting well forward; distal margin broad.

Teeth fixed, strong, slightly curved, cardiform. Teeth on both palate and upper jaw arranged in two (rarely one) row(s) with distinct naked space between rows, teeth in inner row longer. One row of teeth on lower jaw; naked space at symphysis. Four elongate patches of teeth across palate: inner pair adjoining and half as wide as curved outer patches. Palate smooth; two long, low ridges of epithelial tissue before branchial chamber.

Head shield completely smooth except for slightly roughened lateral margins. Dorsomedian head groove lanceolate, flat, beginning well forward on snout and almost reaching base of supraoccipital process. Process narrow, with straight sides, rounded from side to side. Sides of head smooth. Broad-based, triangular humeral process smooth, weakly ossified anteroventrally, its shaft short, oblique, extending one quarter distance along pectoral spine. Axillary pore small.

Barbels thin, flattened. Maxillary barbel short, reaching only to preopercular margin. Mandibular barbel long, extending past head or as far as anterior dorsal rays. Mental barbel reaches ventral head margin or beyond pectoral base. Chin barbel bases clearly staggered.

Gill rakers stiff, moderately pungent, half as long as opposing gill filaments. Gill arches smooth; no rakers on posterior face of first two; 10-12 rakers along back of third arch. No thickened tissue posterodorsally on arches.

Fin spines feeble, rounded, pungent in smallest specimen; smooth or roughened along anterior margin, weakly serrated or roughened along posterior margin (smallest specimen with 8-9 serrae along posterior margin of pectoral spine). Dorsal fin truncate in outline, longest ray 2.3-2.8 times longer than last ray. Pectoral fin low on sides, its base in a horizontal plane; fin hind margin truncate above, concave below. Pectoral fin reaching to below dorsal. Ventral fin of both sexes broad,

terminating well short of anal fin origin. Adipose fin above anterior two-thirds of anal. Anal fin margin almost straight, longest ray 2.6-3.1 times last ray in length. Caudal fin lobes broad and short.

Caudal peduncle stout. Lateral line straight, curved dorsad at tail base. Numerous fine short lines emanate from lateral line, forming dense, branching network anteriorly. Indistinct vertical series of pores ascend from lateral line over upper sides.

Colour of fresh material. Pale grey to yellowish above, white below; colours well-separated. Barbels grey or cream; mouth 'honey'-coloured. Dorsal, ventral, anal and pectoral fins bright yellow-orange; caudal fin dull yellow-orange.

Colour of preserved material. Charcoal or dark lilac-brown above, upper jaw and undersides pale. Lower sides and underside of head cream or pinkish, colour extending dorsally along gill membranes; nostrils and eyes also in pale streaks. Dorsal, pectoral and ventral fins dusky yellow basally, charcoal distally or over dorsal aspect; anal and caudal fins dull yellow or pale orange. Peritoneum pale.

Comparisons. This species is distinct in dentition, body form and colouration. Its colouration is similar to that of *Arius dioctes* and its strong teeth and small eyes link it to that species and to *A. armiger* De Vis, 1884. The only other species with a skin-covered eye is *Doiichthys novaeguineae* Weber, 1913 which also has an upturned mouth. Nevertheless, none of them have *A. insidiator*'s flattened body, peculiar swimbladder form (flattened and elongate versus cardiform and inflated) and angular pleural ribs.

Distribution. *New Guinea:* southern coast along the Gulf of Papua. *Australia:* northern coast east of Darwin. Probably more widespread (for example, individuals have been seined in the Fly River delta (C. Tenakanai, pers. comm.).

Ecology. Shallow mudflats and river mouths; muddy coastal waters.

Remarks. The holotype is the largest specimen known.

Etymology. Noun in apposition; from the Latin, *insidiator*, meaning ambusher or lurker. The dorsally placed eyes and depressed body form suggest that this species' habit is to lie half-hidden in sediment. Its strong teeth and jaws indicate it is a predator. Although large fish scales and detritus were adhering to the gills of the largest specimen, the stomachs of all were empty.

***Arius pectoralis* sp. nov.**

(Figs 5-6; Tables 1, 3)

Arius species 3 - Kailola 1990b: 397.

Arius sp. 3 - Blaber, Brewer and Salini 1994: 168, fig. 3m.

Type material. HOLOTYPE - AMS I.27415-001, 226 mm SL, Chapman River, Queensland (14°56' S,

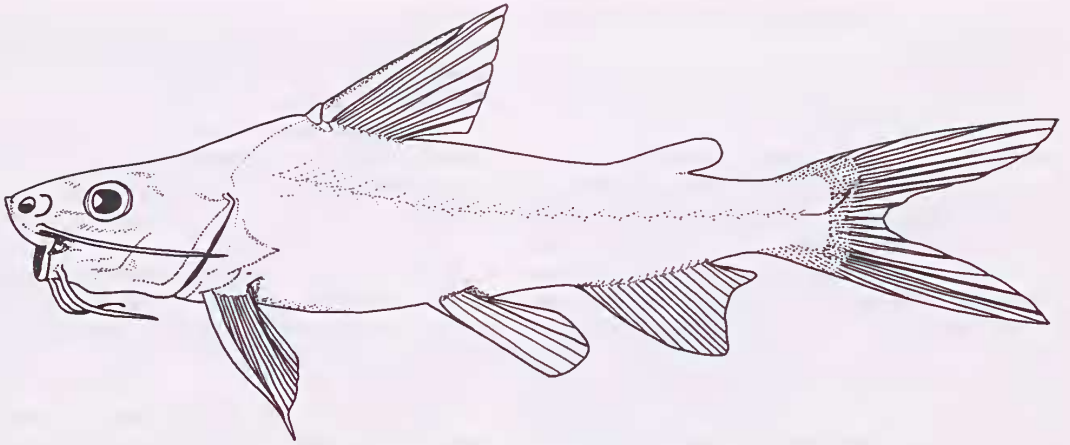


Fig. 5. *Arius pectoralis* sp. nov. lateral view, holotype.

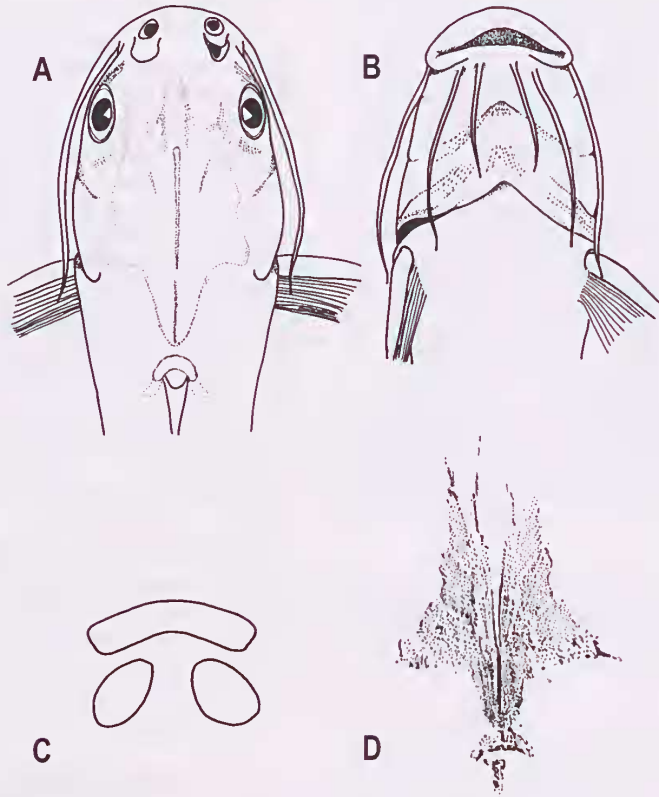


Fig. 6. *Arius pectoralis* sp. nov. (all of holotype) A, dorsal head view; B, ventral head view; C, arrangement of upper tooth patches, D, rubbing of head shield.

141°38' E), D.B. Carter, 21 December 1980. PARATYPES - NTM S.13004-001, 127 mm SL, Chapman River, Queensland, D.B. Carter, 5 March 1981; CSIRO A.3608, 112 mm SL, Norman River above Karumba, Queensland (17°29' S, 140°50' E), I.S.R. Munro, 22 October 1972; CSIRO A.3609, 117 mm SL, same data as A.3608; CSIRO A.3610, 116 mm SL, same data as A.3608; QM I.14917, 105 mm SL, Darwin Harbour (12°27' S, 130°46' E), November 1972; NTM S.10254-001, 2 (94.5-101 mm SL), Mickett Creek, Shoal Bay, Melville Island, Northern Territory (12°21' S, 131°00' E), D. Grey, 16 December 1976; NTM S.10319-003, 56 mm SL, Shoal Bay, Melville Island (11°48' S, 130°39' E), D. Grey, 19 October 1972; NTM S.10235-001, 90 mm SL, Shoal Bay, Melville Island, D. Grey, 1 August 1973; NTM S.11507-004, 145 mm SL, Ludmilla Creek, Darwin (12°27' S, 130°46' E), G. Cole and A. Howard, 19 December 1984; CSIRO H.5174-07, 4 (165-180 mm SL), Papua (Irian Jaya) at 04°52'S, 136°57'E, K. Hortle and A. Haris, 6 September 1997; CSIRO H.4937-02, 220 mm SL, Papua (Irian Jaya) at 04°52'S, 136°57'E, K. Hortle and A. Haris, 6 September 1997.

Additional material examined (non-type). CSIRO H.4220-03, 230 mm SL, Papua (Irian Jaya) at 04°52'S, 136°55'E, K. Hortle and A. Haris, 8 February 1996; NTM S.14852-001, 11 (46-64 mm SL), Papua (Irian Jaya) at 04°52'S, 136°57'E, K. Hortle and A. Haris, 1 June 1998.

Diagnosis. Palatal teeth conical, in two oblique, oval patches; one on each side of palate, well-separated. Snout acute; lips fleshy, crenulate; lower jaw truncate. Head shield finely granular; dorsomedian head groove lanceolate, narrow distally. Eye large, 17-28 % HL. Large, flattened serrae along inner margin of pectoral spine; caudal fin lobes slender, acute. A 18-22; total first arch GR 15-22; rakers present along posterior face of all gill arches; vertebrae 18+6+27. Distinct, blackish margin on dorsal, pectoral and inner caudal fins.

Description. D 17, P 1, 8-11. A 18-22. GR (first arch) 15-22, of which 5-7 on upper limb. GR (last arch) 14-17. Vertebrae 51 (44 free).

Body moderately slender; predorsal profile straight. Snout moderately to slightly acute; lips fleshy, crenulate; short, transverse crescent often present on dorsum of snout between nostrils. Mouth subinferior, gape moderately large; upper jaw somewhat acute medially, lower jaw almost truncate. Anterior nostril slightly medial to posterior one. Eye large, border free from head skin, dorsolateral and slightly before mid-head length. Gill opening moderately wide, concave at isthmus, margin moderately broad.

Teeth in jaws fine, sharp, depressible, forming 7-8 irregular series in upper jaw and 4-6 series in lower jaw, bands either meeting or slightly separated at jaw midlines. Single large, oval patch of conical, blunt teeth

on each side of palate anteriorly, obliquely situated, well-separated. Palate smooth or slightly papillose; two oblique, low to moderately developed epithelial ridges posteriorly on palate.

Head shield finely granular. Dorsomedian head groove originates between nostrils and reaches supraoccipital process base. Groove flat, lanceolate anteriorly, narrow and straight posteriorly. Supraoccipital process triangular, straight-sided, with median keel. Triangular humeral process rugose, well-ossified anteroventrally, its shaft oblique, extending one-third along pectoral spine. Axillary pore small.

Barbels flattened, moderately thick, fleshy. Maxillary barbel extends slightly beyond dorsal fin in juveniles, to humeral process in adults. Mandibular barbel usually reaches pectoral fin spine base. Mental barbel reaches ventral head margin. Chin barbel bases slightly staggered.

Gill rakers short, one-third to half length of opposing filaments. Rakers present along posterior aspect of all arches: 6-7 (upper limb only) to 11-14 (total) on first arch; 13-18 along second; 11-16 along third. Often some papillae on first two arches. Fleshy, scalloped epithelial folds moderately developed posterodorsally on first two arches.

Fin spines strong, moderately long; sides with fine, longitudinal striae. Short filament on tip of spines. Anterior spine margin finely rugose with several sharp, antrorse serrae near tip; posterior (trailing) margin with low (dorsal spine) or large and flattened (pectoral spine) serrae: 8-11 along dorsal, 12-13 along pectoral. Last dorsal fin ray 2.9-3.4 times shorter than longest ray. Pectoral fin extends to below posterior dorsal fin rays. Ventral fin in males narrow, failing to reach anal origin by distance of half eye diameter; in females, broad-based, reaching to fourth anal ray (inner ventral fin rays thickened to form a pad in sexually mature female fish). Adipose fin rectangular, situated above middle of anal fin. Anal fin margin slightly concave, last ray 2.5-3 times shorter than longest ray. Caudal fin lobes slender, tapered, acute, upper lobe slightly longer.

Caudal peduncle moderately stout. Lateral line straight along sides, oblique below dorsal fin, turned dorsad at tail base. Fine, short lines of pores diverge off length of lateral line.

Colour of fresh material. Dark bluish brown or black above, white to cream below. Charcoal or black margin to fins (particularly caudal fin) and anterior two-thirds of anal fin also charcoal.

Colour of preserved material. Dusky fawn to charcoal above, creamy below; colours well-separated. Maxillary barbel usually dark. Unpaired fins and dorsal aspect of pectoral and ventral fins dusky or charcoal; distinct charcoal or black margin to inner caudal, dorsal and pectoral fins, and charcoal anal fin. Peritoneum pale, occasionally with scattered, dark stipples.

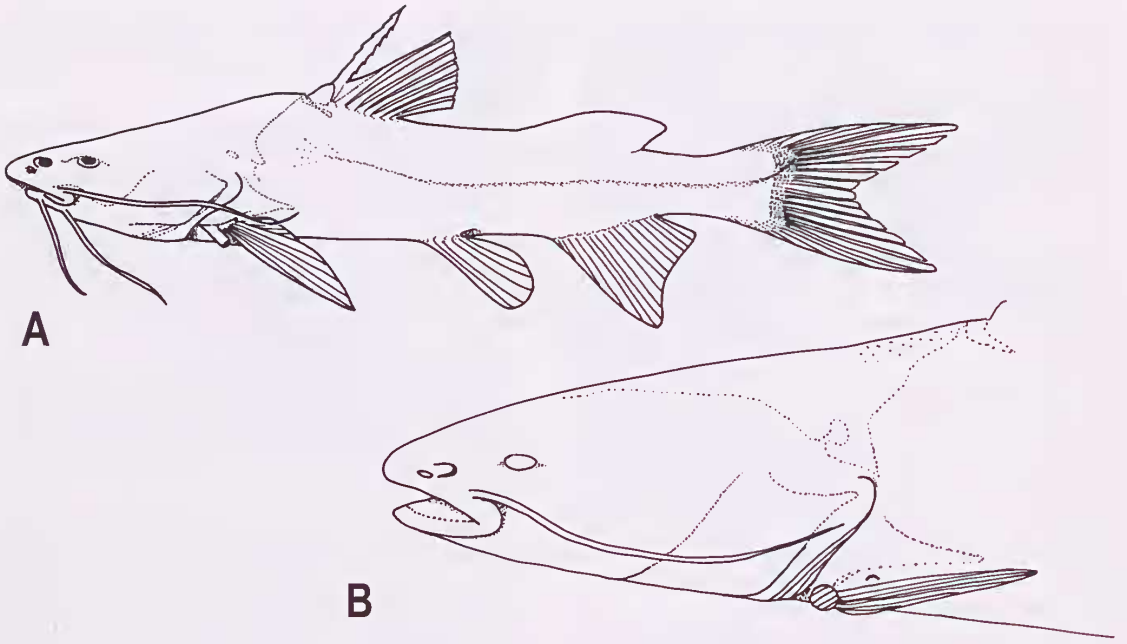


Fig. 7. *Arius hardenbergi* sp. nov. A, lateral view of 74.3 mm SL paratype; B, lateral head view of 253.8 mm SL paratype.

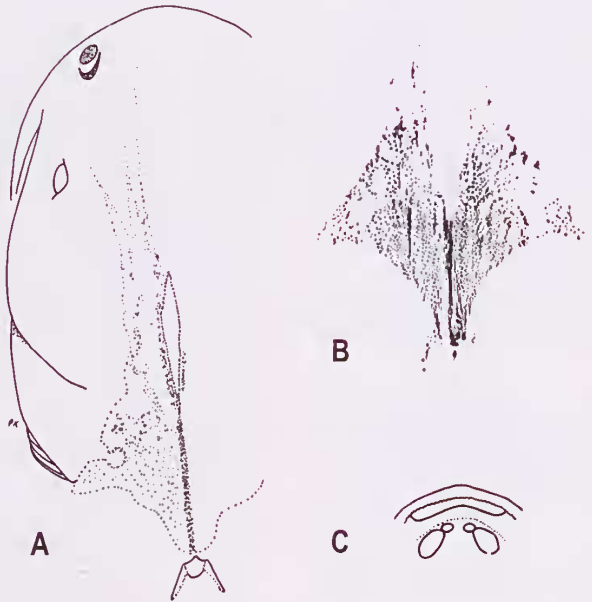


Fig. 8. *Arius hardenbergi* sp. nov. A, dorsal head view sketch of 253.8 mm SL paratype; B, rubbing of head shield, same paratype; C, arrangement of upper tooth patches, 74.3 mm SL paratype.

Table 3. Percent of head length (HL) and standard length (SL) for *Arius pectoralis* sp. nov. and *Arius hardenbergi* sp. nov. n = sample size; \bar{x} = mean; SD = standard deviation.

Character	<i>Arius pectoralis</i>					<i>Arius hardenbergi</i>				
	holotype	n	range	\bar{x}	SD	holotype	n	range	\bar{x}	SD
Percent of SL										
head height	60.9	16	51.0 - 64.4	58.9	4.8	47.0	5	47.0 - 55.6	51.0	3.1
head width	68.9	16	63.5 - 73.5	69.6	3.0	73.0	5	71.9 - 76.2	71.8	5.4
eye diameter	19.4	16	17.1 - 28.0	23.2	3.5	10.1	5	8.4 - 11.3	9.6	1.2
mouth gape	40.2	15	29.5 - 43.6	38.8	4.8	40.9	5	40.9 - 54.1	50.8	5.6
internostril distance	25.0	15	20.6 - 28.4	25.0	2.2	25.9	5	25.9 - 35.5	30.4	3.4
snout length	38.5	16	33.5 - 41.2	37.5	2.2	35.6	5	34.5 - 39.3	37.1	2.0
longest barbel length	79.9	15	78.0 - 121.7	101.0	13.1	76.7	5	76.7 - 110.5	86.6	23.2
bony interorbital width	29.4	15	26.3 - 33.0	29.8	2.0	31.7	5	29.9 - 34.3	32.1	1.9
occipital proc. length	28.2	15	28.2 - 38.2	33.9	2.5	-	4	26.9 - 41.6	31.5	7.3
occipital proc. width	19.4	15	18.7 - 26.0	21.8	2.8	-	4	5.4 - 34.1	18.2	12.0
Percent of HL										
HL	29.2	16	25.5 - 29.8	27.3	1.3	32.1	5	31.9 - 32.9	31.5	1.7
head height	17.8	16	14.4 - 17.8	16.1	1.0	15.1	5	15.1 - 17.9	16.5	1.1
head width	20.1	16	17.3 - 21.0	19.0	1.1	23.5	5	23.4 - 24.5	23.9	0.5
eye diameter	5.7	16	2.1 - 7.3	6.0	1.3	3.2	5	2.7 - 3.6	3.1	0.4
mouth gape	11.7	15	8.5 - 13.8	10.6	1.3	13.1	5	13.1 - 17.8	16.4	1.9
internostril distance	7.3	15	5.7 - 8.0	6.8	0.6	8.3	5	8.3 - 11.3	9.8	1.1
snout length	11.2	16	9.1 - 11.7	10.2	0.8	11.4	5	11.3 - 12.7	12.0	0.7
longest barbel length	23.3	15	22.4 - 32.8	27.5	3.1	24.6	5	24.6 - 36.1	30.4	5.5
bony interorbital width	8.6	15	7.1 - 9.8	8.2	0.8	10.2	5	9.8 - 11.0	10.4	0.5
occipital proc. length	8.2	15	8.2 - 10.6	9.3	0.8	-	4	3.0 - 14.1	8.5	4.5
predorsal length	37.9	16	35.2 - 40.0	36.9	1.5	42.0	5	39.2 - 42.0	40.5	1.3
length dorsal f. base	11.9	16	10.0 - 12.5	11.3	0.7	12.5	5	10.6 - 13.9	12.3	1.2
interdorsal length	27.7	16	16.5 - 33.7	28.2	3.7	26.2	5	14.3 - 26.2	18.5	5.1
length adipose f. base	8.5	16	6.7 - 11.5	8.5	1.3	12.1	5	11.7 - 18.9	16.0	3.7
length anal f. base	17.6	15	15.3 - 19.3	17.1	1.2	14.5	5	12.5 - 16.9	15.0	1.7
caudal ped. depth	8.0	16	7.1 - 8.7	7.9	0.5	7.6	5	6.9 - 7.8	7.4	0.4
caudal ped. length	15.9	16	15.2 - 20.2	17.0	1.2	14.8	5	14.6 - 17.8	15.9	1.3
pectoral spine length	19.8	15	19.5 - 26.0	21.4	1.7	21.8	3	17.3 - 21.8	19.9	2.3
dorsal spine length	21.7	14	19.0 - 27.3	21.9	2.0	15.3	4	15.3 - 18.8	16.9	1.5

Comparisons. *Arius pectoralis* is most similar to *Arius berneyi* (Whitley, 1941) and *A. graeffei* Kner and Steindachner, 1866, from which it can be distinguished by its more acute snout, palatal dentition (almost always a single patch on each side, compared with almost always two patches each side in *A. graeffei* and *A. berneyi*); also, palatal teeth finely conical instead of villiform in *A. graeffei* and *A. berneyi*), its strong pectoral spine serrae, very dark fin margins and slender caudal fin. *Arius pectoralis* differs from the only other taxon in the area with similar palatal dentition (*Cinetodus froggatti* (Ramsay and Ogilby, 1886)) by its wide gill opening and head shield form (restricted gill opening and very broad and high head shield in *C. froggatti*).

Distribution. *New Guinea*: south coast and estuaries of Papua (Irian Jaya) from the Kamora to Otokwa rivers. Probably occurs more extensively, in pockets, including the Port Moresby to the Kempwelch River area in central southern Papua New Guinea. *Australia*: Darwin (harbour and Ludmilla Creek) to Karumba and the Chapman River in Queensland.

Ecology. Coastal waters, estuaries and rivers within tidal influence; among mangroves.

Remarks. There are no literature records of this species, which has probably been confused in the field and earlier reports for *Arius berneyi* or *A. graeffei*. The maximum recorded size for *A. pectoralis* is 393 mm FL (Papua (Irian Jaya) specimen).

Etymology. From the Latin, *pectoralis*, meaning shoulder: refers to the strong serrae along the inner pectoral fin spine.

Arius hardenbergi sp. nov.

(Figs 7-8; Tables 1, 3)

Arius species 6 - Kailola 1990b: 455.

Type material. HOLOTYPE - WAM P.29966-001, 260 mm SL, Manimcri River (02°06' S, 133°45' E), Bintuni Bay, Papua (Irian Jaya), G.R. Allen, 28 March 1989. PARATYPES - NCIP 436, 254 mm SL, Merauke (08°28' S, 140°20' E), Papua (Irian Jaya), J.D.F. Hardenberg, 4 August 1931; AMS I.29291-001, 2 (59.5-74.5 mm SL), delta of Fly River (08°22' S, 142°40' E), Papua New Guinea, J. Watson, 16-22 July 1981; QM I.26088, 56 mm SL, same data.

Additional material examined (non-type). NTM S.14873-001, 52 mm SL, Bamu River estuary, Papua New Guinea, at c. 08°08' S, 143°35' E, 21 June 1993.

Diagnosis. Four patches of conical teeth across front of palate: rounded vomerine patches well-separated; outer patches oval or crescentic, 2-3 times larger than inner patches. Snout fleshy, overhanging mouth. Low papillae on palate and posterior face of gill arches; rakers rarely on posterior face of first two gill arches. Barbels thick proximally, thin distally. Head shield very granular, extensive posteriorly; triangular supraoccipital process short, broad. Eye small, dorsolateral, 8-12% HL. A 16-18; total gill rakers (first arch) 10-14; vertebrae 19+5+26. Adipose fin large, base longer than anal fin base. Fresh colouration dark grey; inner, dorsal aspect of paired fins charcoal blue.

Description. D I, 7. P I, 9-10. A 16-18. GR (first arch) 10-14, of which 3-5 on upper limb. GR (last arch) 9-13. Vertebrae 50-52 (43-46 free).

Body robust. Head broad, depressed; predorsal profile almost straight, slightly convex at nape. Snout rounded to slightly acute, prominent; lips moderately thick and fleshy, inner margin crenulate. Tiny, fine papilla-like structures on snout and around mouth in all specimens. Mouth very broad, curved, more inferior than sub-terminal; one-quarter to half of upper jaw tooth band exposed when mouth closed. Nostrils rounded, anterior one slightly lateral to posterior one. Eye small, not completely free of head skin, situated dorsolaterally, well to slightly before mid-head length. Gill opening moderately wide, united membrane concave over isthmus, margin broad and free.

Teeth conical, tips sharp or compressed; very slightly depressible; embedded in thick tissue. Five to eight irregular series of teeth in premaxillary band, 4 to 6 in lower band; narrow edentulous space at symphysis of lower jaw. Four tooth patches across front of palate, separated by narrow spaces. Vomerine patches rounded; outer patches large, oval, at least twice as large as vomerine patches. Palate smooth or with few scattered low papillae; two low oblique ridges of epithelial tissue before branchial chamber.

Head shield extensive, very granular, granules low, coarse in large individuals. Ridges of striae flank dorsomedian head groove posteriorly; broader striae extend over supraoccipital process. Groove lanceolate, beginning on snout, extending to base of supraoccipital process; groove flat anteriorly, narrow and deeply excavated posteriorly. Supraoccipital process broad, triangular; sides almost concave; strong median keel. Sides of head slightly venulose; small, oval, naked space in head shield above operculum. Humeral process broad-based, heavily ossified anteroventrally; its triangular shaft extending one-third distance along pectoral fin spine. Axillary pore moderately large.

Barbels flat, thick proximally, thin and wisp-like distally. Maxillary barbel extends to base of pectoral fin or to below dorsal fin base (juveniles). Mandibular barbel reaches pectoral fin base. Mental barbel ends

midway between eye and pectoral fin base. Bases of chin barbels moderately staggered.

Gill rakers well-spaced, half as long as opposing filaments. Numerous, low papillae along back of first two gill arches (fewer in larger fish); no rakers on posterior face of first arch; rarely 1-3 rakers posterodorsally on second arch; 9-10 rakers on posterior face of third arch. Narrow pads of epithelial tissue on gill arches posterodorsally, best developed on second.

Fin spines robust, tips sharp. Outer spine margin with low granules and 1-3 serrae distally; posterior margin with 3-5 serrae (dorsal spine) or 5-10 large antrorse serrae (pectoral). Longest dorsal ray 1.9-2.2 times last ray. Pectoral fin extends to below mid-dorsal fin. Ventral fin short of or reaches anal fin origin (condition in mature females unknown). Adipose fin oblong, long-based, beginning noticeably before anal fin origin, opposite all of anal fin. Anal fin margin concave, longest ray 2.4-3.2 times last ray. Caudal fin moderately short, lobes broad, tapered.

Caudal peduncle moderately deep. Lateral line turned dorsad at tail base, elevated below dorsal fin. Low, short lines of pores diverge from length of lateral line, more abundant anteriorly.

Colour of fresh material. Brown to dusky mauve above, pale yellow or fawn below; iridescent gold on sides. Fins dusky mauve or brown. Barbels pale yellow.

Colour of preserved material. Light brown or tan, paler below; fins brown; barbels fawn. Peritoneum pale.

Comparisons. *Arius hardenbergi* can be distinguished from the similar *Arius proximus* (Ogilby, 1898) by its larger adipose fin (12-19% SL, compared with 6-12% in *A. proximus*), mouth shape, eye diameter (8-12.5% HL, compared with 14-28% in *A. proximus*), extent of head shield, supraoccipital process shape, and swimbladder form (margins smooth versus scalloped in *A. proximus*). The supraoccipital and mouth shapes, paired fin colouration and adipose fin size of *A. hardenbergi* are similar to those of *Cinetodus* (Kailola 1990b). However, the taxa belonging to that genus have rakers along the posterior face of the first two gill arches, different palatal dentition and more restricted gill opening. *Cinetodus carinatus* (Weber, 1913) can be confused with *A. hardenbergi* but *C. carinaus* has more gill rakers on the first gill arch (15-19) and more and stronger serrae along the inner pectoral spine.

Distribution. *New Guinea*: south coast. Vogelkop Peninsula to the Fly River mouth.

Ecology. Muddy, shallow coastal waters and tidal rivers.

Remarks. On a label attached to the largest specimen from Merauke, is written '*Arius uniformis* Hardenberg'. Hardenberg did not publish a description, and there is no unpublished manuscript at the ZMA. This name is therefore not available.

This species probably attains a larger size, although the maximum size specimen I have measured is 254 mm

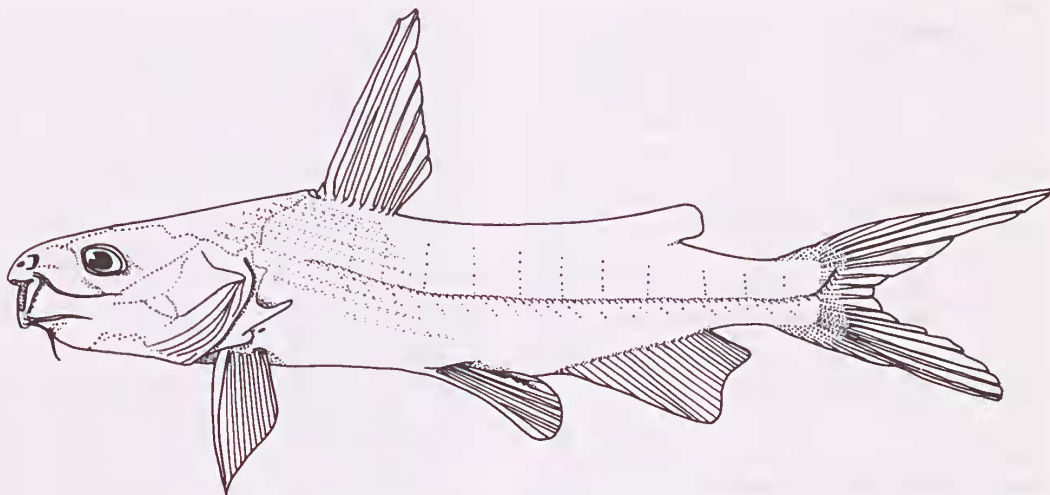


Fig. 9. *Arius hainesi* sp. nov. lateral view, 228 mm SL paratype.

SL. It could have been mistaken in collections for several other species such as *Arius proximus* (Ogilby) and members of the genus *Cinetodus*.

Etymology. I name this species after J.D.F. Hardenberg, not only because he recognised that the species was new but also as an acknowledgement of his insightful contributions to Indo-Australian ichthyology in the mid-twentieth century.

***Arius hainesi* sp. nov.**
(Figs 9-11; Tables 1, 4)

Nedystoma dayi - Tortonese 1964: 24.

Nedystoma dayi (in part) - Kailola 1975: 42.

Nedystoma sp. - Liem and Haines 1977: 25.

Arius species 4 - Kailola 1990b: 459.

Arius sp. 4 - Blaber, Brewer and Salini 1994: 168, fig. 3n.

Type material. HOLOTYPE - NTM S.11507-001, 304 mm SL, Ludmilla Creek (12°27' S, 130°46' E), Darwin, Northern Territory, G. Cole and A. Howard, 19 December 1984. PARATYPES - AMS I.25995-001, 204 mm SL, Baimuru (07°33' S, 144°51' E), Papua New Guinea, A.K. Haines, 12-14 September 1974; QM I.22657, 228 mm SL, Morowan (07°35' S, 144°58' E), Ini Island, Papua New Guinea, A.K. Haines, 15 May 1975; AMS I.27414-001, 237 mm SL, same data, 237 mm SL (cleared and stained); USNM 288553, 135 mm SL, Gulf of Papua (08°00' S, 145°00' E), S. Frusher, 13 July 1981; AMS I.25996-001, 136 mm SL, Gulf of Papua, A.K. Haines, May 1975; CSIRO C.3799, 187 mm SL, Norman River at Karumba (17°29' S, 140°50' E), Queensland, D.J. Turner, 1969; NTM S.10190-002, 2

(88.0-88.2 mm SL), Mickett Creek (12°21' S, 131°00' E), Melville Island, Northern Territory, D. Grey, 26 June 1975 (larger specimen cleared and stained); CSIRO H.4545-01, 2 (120.4-125.9 mm SL), Papua (Irian Jaya) at 4°56.6'S, 137°03.2'E, K. Hortle and A. Haris, 4 September 1996; CSIRO H.4937-03, 222.5 mm SL, Papua (Irian Jaya) at 4°52.1'S, 135°57.7'E, K. Hortle and A. Haris, 6 September 1997; CSIRO H.5252-01, 2 (210-234 mm SL), Papua (Irian Jaya) at 4°53.8'S, 136°54.6'E, K. Hortle and A. Haris, 6 September 1997.

Additional material examined (non type material). KFRS F.O3990, 181.5 mm SL, Murua (07°52' S, 145°47' E), Matupi River, Papua New Guinea, October 1971; KFRS F.O4093, 3 (115-193 mm SL), off Oreke River mouth (08°42' S, 146°29' E), Papua New Guinea, P. Kailola and J. Koaia, 3-4 May 1973; CSIRO H.4958-01, 12 (33-42 mm SL), Papua (Irian Jaya) at 4°52.4'S, 136°57'E, K. Hortle and A. Haris, 1 June 1998 (mouth juveniles); CSIRO H.5174-06, 210 mm SL, Papua (Irian Jaya) at 4°52.6'S, 136°56.5'E, K. Hortle and A. Haris, 6 September 1997; WAM P.29965-002, 94 mm SL, Manimeri River (02°06' S, 133°45' E), Papua (Irian Jaya), G.R. Allen, March 1989; AMS I.27413-001, 2 (108-151 mm SL), Arehava (07°35' S, 144°57' E), Papua New Guinea, A.K. Haines, September 1974.

Diagnosis. Palate without teeth (but autogenous tooth plates present); jaw teeth slender, in short, oblong band. Lips fleshy, thin; mouth small, lower jaw truncate. Barbels thin, short, maxillary barbel reaching only just beyond eye; bases of chin barbels close together. Eye large, 14-24 % HL, lateral. Dorsomedian head groove elongate, deep posteriorly. Gill rakers along posterior

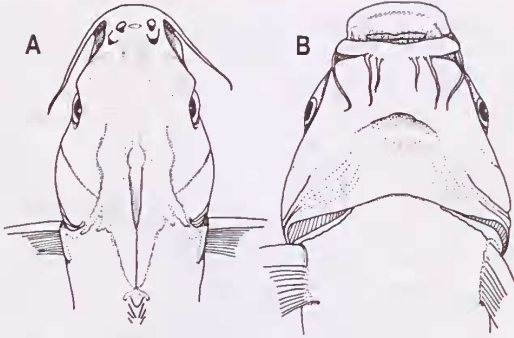


Fig. 10. *Arius hainesi* sp. nov. A, dorsal head view (228 mm SL paratype), B, ventral head view (holotype).

of all arches; gill opening slightly restricted; two large epithelial flaps on palate posteriorly and double folds on upper limb of first two gill arches. A 20-23; total gill rakers (first arch) 32-37. Longitudinal furrows anterodorsally on body. Fin spines thin, long, slender; adipose fin short-based, over posterior two-thirds of anal; ventral fin pad of sexually mature females scalloped and tapered. Fresh colouration dark grey above and iridescent purple; palate and branchial chamber often purplish brown to charcoal.

Description. D 1.7. P 1, 8-11. A 20-23. GR (first arch) 32-37, of which 10-12 on upper limb. GR (last arch) 31-37. Vertebrae 49-50 (43-44 free).

Body moderately elongate, cylindrical; head slightly depressed. Predorsal profile straight, abruptly convex at nape. Snout slightly rounded or truncate, curved ventrad, overhanging subinferior mouth. Lips thin, fleshy or 'rubbery', inner aspect spongy and papillose. Mouth gape moderately wide, lower jaw truncate or horizontal; all of premaxillary tooth band visible when mouth closed. Nostrils large, rounded, anterior nostril slightly median to posterior one. Shallow groove usually present on snout between posterior nostrils. Eye large, rounded,

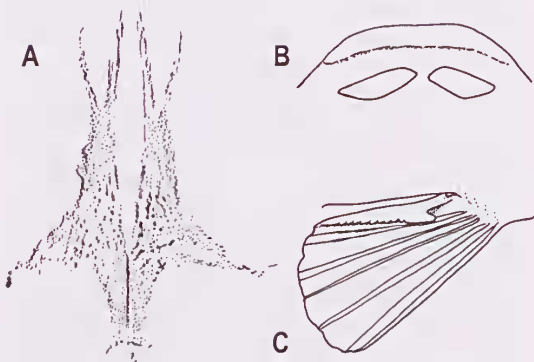


Fig. 11. *Arius hainesi* sp. nov. A, rubbing of head shield (228 mm SL paratype), B, arrangement of upper tooth patches (204 mm SL paratype), C, ventral fin of mature female showing pad of epithelial tissue.

prominent, situated laterally at or slightly before mid-head length, margin free of head skin; lateral ethmoid prominent before eye. Gill openings somewhat restricted ventrally, membranes attached broadly to isthmus, marginly concave.

Teeth in jaws slender, long, depressible; very fine; embedded in tissue; in 5-6 series. Tooth band (both jaws) interrupted at symphyses by edentulous space. Pre-maxillary bands elongate-oval. No teeth on palate. Palate almost smooth or with low, scattered papillae. One large pair of epithelial tissue folds hangs from palate into anterior part of branchial chamber.

Head shield rugose or finely granular. Granules conspicuous, usually sharp, arranged in series along dorsomedian head groove and along edge of shield in larger specimens. Dorsomedian groove begins at level of nostrils and continues to supraoccipital process base; groove flat anteriorly, thence deeply excavated; conspicuous. Rugose supraoccipital process triangular with straight sides; sharp median keel prominent. Naked space in head shield above gill opening. Large venules on sides of head. Lateral head skin and 'shoulder' skin develop 7-10 longitudinal furrows or ridges with age; most apparent in individuals longer than about 150 mm SL. Humeral process triangular, indented above, heavily ossified anteroventrally, shaft oblique, acute; granules arranged in series along process. Moderate sized, slit-like axillary pore present.

Barbels thin, rounded proximally, flattened and wisp-like distally. Maxillary barbel reaches to eye or halfway between eye and gill opening (juveniles); mandibular barbel extends to below middle of eye; mental barbel not or just reaches front eye margin. Chin barbel bases close together, almost transversely aligned.

Gill rakers long, equal to gill filament length. Shorter rakers along posterior face of all arches: 32-36 along first arch, 33-40 on second, 30-34 on third. Curious large double fold (or pouch) of epithelial tissue links upper limb of first two arches.

Fin spines long, slender, rather compressed; sides smooth to finely striate; anterior border with sharp granules or ridges. Low serrae along distal part of dorsal fin spine hind border and 25-35 sharp, large retrorse serrae along pectoral fin spine hind border. Last dorsal fin ray 3.0-3.7 times in longest ray. Pectoral fin reaches just beyond dorsal fin. Ventral fin narrow in males, reaching second or third anal fin ray; broad in females, extending to about fifth anal fin ray; mature females with curiously-shaped thickening along dorsal aspect of sixth ray consisting of series of lobes and proximally a short, lateral horizontal process (Fig. 11C). Adipose fin short-based, oblong; above middle of anal fin. Outer margin of anal fin truncate (adult) to deeply concave (juveniles), last ray 2.8-3.2 times in longest ray. Caudal fin lobes narrow, tapered, upper lobe slightly the longer.

Caudal peduncle moderately deep. Lateral line elevated below dorsal fin, curved dorsad at tail base. Thin, dorsally-directed branchlets of lateral line conspicuous; vertical series of fine pores diverging from lateral line extend over upper body surface.

Colour of fresh material. Iridescent charcoal-purple on head and back, otherwise dark grey or brown above, white below. Sharp division between dorsal and ventral colours. Fins pale. Lining of mouth and branchial chamber either white to cream, or purplish brown to charcoal.

Colour of preserved material. Dark brown or charcoal grey over upper two-thirds of head and body, pale orange-fawn or dusky grey below. Both lips pale. Dorsal, adipose and caudal fins dusky tan with broad, brown margins. Upper aspect of pectoral fin dark grey or brown; upper ventral fin, anterior anal fin rays and anal fin margin dusky. Palate and branchial chamber pale to dark brown or charcoal. Barbels brown.

Comparisons. *Arius hainesi* superficially resembles *Nedystoma dayi* (Ramsay and Ogilby, 1886) in having a toothless palate, epithelial folds around and before the anterior gill arches, and many gill rakers. However, the

Table 4. Percent of head length (HL) and standard length (SL) for *Arius hainesi* sp. nov. n = sample size; \bar{x} = mean; SD = standard deviation.

Character	<i>Arius hainesi</i>				
	holotype	n	range	\bar{x}	SD
Percent of HL					
head height	54.8	14	45.6 - 65.1	55.2	5.5
head width	68.1	14	52.3 - 74.6	66.4	5.7
eye diameter	14.1	14	14.1 - 23.8	18.7	2.5
mouth gape	34.0	14	27.5 - 37.9	32.2	2.8
internostil distance	18.4	14	15.6 - 19.1	18.2	0.9
snout length	43.3	14	38.2 - 43.3	40.6	1.7
longest barbel length	34.2	14	28.9 - 55.8	42.1	7.7
bony interorbital width	28.0	14	27.0 - 42.6	30.1	3.7
occipital proc. length	28.0	14	22.9 - 50.0	30.3	6.6
occipital proc. width	12.1	14	12.1 - 20.5	16.6	2.3
Percent of SL					
HL	32.1	14	27.7 - 33.0	30.4	1.9
head height	17.6	14	15.0 - 18.4	16.7	1.2
head width	21.9	14	17.3 - 21.9	20.1	1.4
eye diameter	4.5	14	4.5 - 6.6	5.7	0.6
mouth gape	10.9	14	8.4 - 12.1	9.8	1.1
internostil distance	5.9	14	4.9 - 6.0	5.5	0.4
snout length	13.9	14	10.8 - 13.9	12.4	1.1
longest barbel length	11.0	14	9.5 - 15.8	12.7	1.9
bony interorbital width	9.0	14	8.0 - 12.8	9.2	1.2
occipital proc. length	9.0	14	7.5 - 13.9	9.1	1.5
predorsal length	40.8	14	36.5 - 42.2	39.6	1.6
length dorsal f. base	11.6	14	9.9 - 12.3	11.2	0.6
interdorsal length	28.1	14	25.9 - 31.0	28.8	1.5
length adipose f. base	6.2	14	4.5 - 9.4	6.7	1.4
length anal f. base	17.0	14	17.0 - 19.9	18.5	1.0
caudal ped. depth	8.3	14	7.1 - 8.5	7.9	0.4
caudal ped. length	15.4	14	13.9 - 17.6	15.8	1.1
pectoral spine length	23.0	11	19.2 - 25.1	22.7	2.0
dorsal spine length	23.4	11	21.4 - 26.4	23.9	1.4

shapes of the posterior head groove and mature female ventral fin, the short barbels (maxillary barbel 29-56 % HL, compared with 46-76 % HL in *N. dayi*), longer snout (38-43 % HL, compared with 30-36 % HL in *N. dayi*) are among distinguishing characters. The two species also apparently occupy different habitats (*N. dayi* is almost strictly freshwater). Tortonese's (1964) '*Nedystoma dayi*' from Katau (09°08' S, 142°56' E) must be referable to this species.

Distribution. *New Guinea:* southern coast from Kamora to Otokwa rivers (Papua (Irian Jaya)) and from Katau (west of Fly River delta) to Aird Hills and Oreke River (Papua New Guinea); possibly continuous distribution and more extensive westwards. *Australia:* from vicinity of Darwin to the southern Gulf of Carpentaria.

Ecology. Predominantly in marine waters of the lower estuaries, along the coast and off river mouths. In Papua New Guinea the species is common locally (such as the Era River - Morowan area) (Haines 1979) although in central-southern Papua (Irian Jaya), *A. hainesi* is common in the estuaries.

Remarks. *Arius hainesi* attains a maximum size of 320 mm FL (Papua (Irian Jaya) material).

Etymology. Named for Alan K. Haines, who worked in fisheries in Papua New Guinea between 1972 and 1976. He undertook several surveys of river systems entering the Gulf of Papua (notably the Purari) and developed a sound appreciation of those river systems and their aquatic fauna. Through his ability to distinguish the species and his faithful recording of the biology and ecology of the fork-tailed catfishes in the Gulf rivers, Alan made a significant contribution to our knowledge of this fish family in the Australian and New Guinea region.

Arius paucus sp. nov.
(Figs 12-13; Table 5)

Arius midgleyi Kailola and Pierce, 1988: 75 (in part).

Type material. HOLOTYPE - QM I.12910, 326 mm SL, Flinders River near Maxwellton (20°47' S, 142°43' E), Queensland, H. and M. Midgley, 14 October 1974 (paratype of *Arius midgleyi*). PARATYPES - QM I.12757, 310 mm SL, Flinders River near Maxwellton, H. and M. Midgley, 14 October 1974 (paratype of *Arius midgleyi*); QM I.16730, 2 (315-329 mm SL), Flinders River near Maxwellton, H. and M. Midgley, October 1974 (paratypes of *Arius midgleyi*); QM I.11364, 205 mm SL, Forest Home Station (18°15' S, 143°02' E), Gilbert River, Queensland, T.C. Marshall, 24 September 1953 (paratype of *Arius midgleyi*); AMS I.25315-001 (previously IB.3159/2882), 171 mm SL, same data (paratype of *Arius midgleyi*); QM I.11990, 145.5 mm SL, Mitchell River (16°00' S, 142°20' E), Queensland, 8 September 1959, (paratype of *Arius midgleyi*); QM I.16735, 240 mm SL, Hodgson River (14°54' S, 134°33' E), Northern Territory, H. and M. Midgley, 17 September

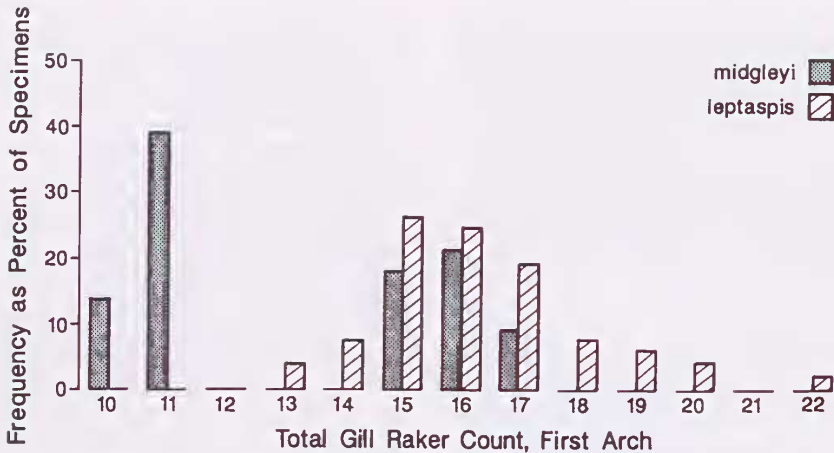


Fig. 12. Range of total gill raker count (first arch) of *Arius midgleyi* and *A. paucus* sp. nov. (species combined) and 57 specimens of *Arius leptaspis* (Bleeker) from northern Australia and southern New Guinea. *Arius paucus* sp. nov. counts are at the left of the figure.

1979 (paratype of *Arius midgleyi*); QM I.16738, 2 (327 mm SL and 151.5 mm HL), Mannaburoo Hole (16°05' S, 135°22' E), Limmen Bight River, Northern Territory, H. and M. Midgley, 29-30 August 1979 (paratypes of *Arius midgleyi*); NTM S.12070-001, 2 (298-315 mm SL), same data (paratypes of *Arius midgleyi*); QM I.16737, 310 mm SL, same locality, H. and M. Midgley, 1 September 1979 (paratype of *Arius midgleyi*); NTM S.12083-001, 331 mm SL, Wilton River (13°46' S, 134°28' E), H. and M. Midgley, 25-27 September 1979 (paratype of *Arius midgleyi*); NTM S.1775, 257 mm SL, Wologorang Station (17°13' S, 137°57' E), Northern Territory, D. Howe, 15 June 1974 (paratype of *Arius midgleyi*); CAM F.36, 273 mm SL, same data (paratype of *Arius midgleyi*).

Additional material (non-type). QM I.16741, 2 (123.5-131 mm HL), McArthur River (24°46' S, 143°44' E), Queensland, H. and M. Midgley, June 1975; NTM S.12077-001, 107.5 mm HL, Roper River (14°46' S, 134°01' E), Northern Territory, H. and M. Midgley, September 1979; NTM S.11153-001, 110 mm HL, Mainoru River (14°01' S, 134°03' E), Northern Territory, H. and M. Midgley, September 1979.

Diagnosis. Gill rakers total 10-11 on first gill arch, 11-14 on last arch. Eye diameter as percentage of head length 9-15. In addition, the characters of *Arius midgleyi* Kailola and Pierce: sleek body; strong jaws; jaws upturned slightly at symphyses, mouth broad; snout truncate in profile; head oblong, its width averaging 66% HL. Supraoccipital process narrow with parallel margins. Numerous fine, sharp teeth on palate in transverse band of four oblong groups. No rakers on posterior aspect of gill arches. A 16-19; vertebrae 20+7-8+28-29. Barbels thin and short, rarely reaching beyond pectoral fin base and less than 25% SL.

Comparisons. *Arius paucus* differs from *A. midgleyi* in gill raker numbers (10-11 on first arch in *A. paucus*,

versus 15-17 on first arch in *A. midgleyi*) and eye size (8.9-15.3% HL in *A. paucus* versus 12.9-21.8% HL in *A. midgleyi*) (Table 5). No other morphometric characters distinguish these species, although juvenile colouration may be important.

Furthermore, there is a clear disjunction in range of the two species: *A. midgleyi* distributed in the west (the Victoria, Katherine, Daly, Ord, remaining Kimberley and northern river systems including the Alligator); and *A. paucus* distributed in the east (the Roper and Flinders River systems and all other rivers draining into the Gulf of Carpentaria).

Distribution. River systems of the Roper (Limmen Bight, Roper, Hodgson, Wilton and Mainoru), McArthur, Tooganginie Creek, Robertson and Calvert (rare); south-east to the Flinders, Gilbert, Staaten and Edward River systems (Strathgorden Lagoon) on Cape York Peninsula (Midgley 1979, 1980, 1981, 1982, 1983, 1984, pers. comm.).

Remarks. *Arius paucus* and *A. midgleyi* are most closely related to *Arius leptaspis* (Bleeker) and less so, to *Arius latirostris* Macleay, a Papuan endemic. The distinguishing features of these four taxa were described

Table 5. Comparison of key characters between *Arius paucus* sp. nov. and *A. midgleyi*. n = number; \bar{x} = mean; SD = standard deviation; GR 1 = rakers on first gill arch; GR 4 = rakers on last gill arch.

Species	variable	Eye diam. % HL	Total GR 1	Total GR 4
<i>A. midgleyi</i>	holotype	13.3	16	18
	range, n = 14	12.9 - 21.8	15-17	16-19
	\bar{x}	17.1	15.8	17.3
	SD	3.2	0.7	0.9
<i>A. paucus</i>	holotype	9.1	11	13
	range, n = 16	8.9 - 15.3	10-11	11-14
	\bar{x}	11.0	10.7	12.8
	SD	1.7	0.5	0.8

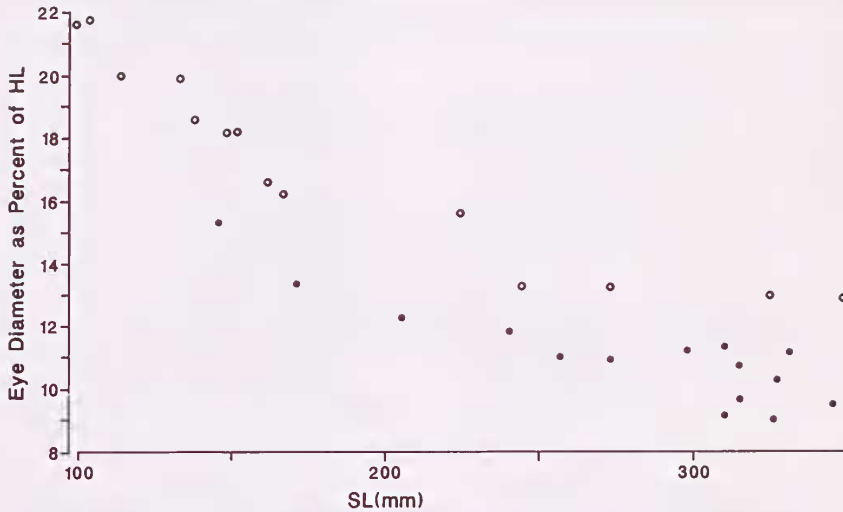


Fig. 13. Comparison of eye size between *Arius midgleyi* (hollow circles) and *A. paucus* sp. nov. (solid circles).

by Kailola and Pierce (1988). *Arius paucus* and *A. midgleyi* are common and widespread in river systems of northern Australia, and attain a large size (to about 28 kg and 1.3 m total length: *A. midgleyi*) (Kailola 1990b).

Etymology. From the Latin, *paucus*, meaning few, or less. Refers to the new species having fewer gill rakers and a smaller eye than does *A. midgleyi*.

ACKNOWLEDGMENTS

I am grateful to the many collectors and collection managers of institutions who have sent me material. I appreciate the more recent support and assistance of Helen Larson (NTM), Grant West, Alastair Graham and Peter Last (CSIRO). Kent Hortle (P.T. Freepport Indonesia, Papua (Irian Jaya)) enabled my access to west New Guinea material and facilitated transfer of material. I thank Hamar Midgley, Gerry Allen and Alan Haines for their insights.

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Accepted 2 November 2000